Video–Enhanced, Hypermedia Presentation of Inspection Requirements for Military Garments

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Abstract

Presenting military apparel specifications in a manner that effectively communicates the requirements that they embody has become an intensely complex task. However, recent advances in computer hardware and software have made it possible to develop information bases that are easily accessible even if there is a massive amount of information and if the concepts conveyed by that data are highly interconnected. Furthermore, these databases may contain any computer manageable form of information including text, graphics, or digital images. The resulting hypermedia databases bridge the communication gap by conveying related requirements through differing forms of presentation. This research report describes the development of a hypermedia presentation of the specifications for the production and evaluation of the Army men's short sleeve dress shirt and for the chemical protective suit. It also describes the process of producing a compact disc that contains both the presentation programs and the corresponding line drawings and digital images that supplement the specifications.

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1.0. Background and Research Objectives

1.1. Background

Presenting military apparel specifications in a manner that effectively communicates the requirements that they embody has become an intensely complex task. Information specifying the material, layout or assembly of a garment, as well as the criteria by which its acceptance will be judged, forms a family of information bases that are both lengthy and intertwined. As a result, ascertaining that a garment, or the process by which it is produced, complies with all requirements is both tedious and error prone. In contrast, recent advances in computer hardware and software have made it possible to develop information bases that are easily accessible even if massive and highly interconnected. Furthermore, these databases may contain any computer manageable form of information including text, graphics, sound, or video. The resulting hypermedia databases bridge the communication gap by conveying related requirements through differing forms of presentation. This research report describes the development of a hypermedia presentation of the specifications for the production and evaluation of the Army men's short sleeve dress shirt and the chemical protective suit.

Recognizing these problems while observing advances in the technology for developing and presenting databases leads one to consider using computers to aid in presenting apparel specifications. The widespread use of multimedia databases depends upon technical developments in the capabilities of the central processing unit (CPU), main memory, and bulk storage units of computers. Each of these developments affect a computer's ability to process the massive volumes of data that arise when non–textual media such as digital sound or video are a part of a database. Storing an image so that it can be presented, for example, may require more than 1 megabyte of main memory just for the image data and the rendering program would need space as well! Storing several images that might be generated during an editing session or cataloging several hundred that might be required to illustrate the details of a specification also places intense demands on computer memory systems. However, computers with fast

CPU's, large main memories and nonvolatile bulk storage devices capable of preserving hundreds of megabytes of data have recently become available.

1.2. Research Objectives

There were two primary goals for this project. The first was to explore the potential to enhance the clarity of specifications by incorporating digital images as supplements to the written requirements. The second was to determine the feasibility of exploiting the mass storage capacity of compact disk (CD) technology for use as a medium through which to distribute specifications. The database incorporates the content of the specification for the manufacture of Army men's short sleeve dress shirt (MIL−S−44041B(GL)) [5], the quality assurance provisions for Army shirts (MIL−STD−1492C) [6], and the production of the chemical protective suit (MIL−S−43926H) [7]. In addition, a framework for developing an entire library of specifications is established. The resulting hypermedia presentation, including the hypermedia interface linkages and approximately 250 digital images, has been preserved on a CD. In the sections that follow, we will describe the development of this apparel specification database. Since the process of constructing the database is intimately intertwined with the facilities afforded by the concepts of hypermedia, we begin by reviewing the basics of hypermedia presentations.

2.0. Hypermedia

2.1. Definitions

The word "hypermedia" was derived from the term "hypertext" which was used first by Nelson[3] to refer to textual information that was organized so that related content could be readily reviewed. The use of hypermedia has been described as a significant paradigm shift in information management systems [1]. It has been applied to organize and to present EPA regulations for underground storage tanks [2]. In addition, Schneiderman and Kearsley [4] cite applications of hypermedia to such diverse areas as dictionaries, encyclopedias, medical texts, catalogs, interactive fiction, religious documents and museum exhibits. As computer technology has advanced, it has become possible to use electronic documents to convey various media forms including audio, graphics, animations and video in addition to simple text. Hypermedia has come to refer to any information base that employs various media and is organized so that related segments of information can be rapidly accessed. Thus, there are two key elements of hypermedia: media and access.

2.2. Media

Any computer manipulable form of information can be embedded in hypermedia. The text and drawings that are parts of a specification can be incorporated as they would be in a paper version. In addition, digitized audio can be used to supply verbal explanations or amplifications of requirements. Digital video can be used to capture images or even brief, motion sequences to illustrate and clarify the textual content. Nevertheless, media by themselves provide only limited improvements over printed documents. It is critical to be able rapidly to access the segments of a specification that bear upon a requirement that is currently of interest.

2.3. Access

Access to related information is provided through a collection of hypermedia navigation tools including buttons, drop–down menus and "hotwords." A button is a region on a computer's display that is typically identified using an icon and has special properties. In particular, if a mouse pointer is used to place the cursor over a button icon and a mouse button is "clicked," then the information represented by the icon will be presented.

Drop–down menus are lists, normally hidden from view, of alternative actions. The lists are summarized by a key word or phrase which appears on a menu bar of the display window. When the mouse cursor is placed on the key word or phrase and a mouse button is depressed, the menu appears. An action can be selected from the menu by sliding the cursor down the menu to the desired item and then releasing the mouse button.

The suite of hypermedia navigation tools is completed with "hotwords," which are segments of the text itself that can function like buttons. A hotword is typically highlighted with italics, a text framing box or a change in the font color. One selects the action associated with the hotword by pointing and clicking with the mouse analogously to the way in which buttons are used. Thus, any piece of the text of a specification can be linked to any other data stored in a hypermedia information base. With the navigation capabilities provided by buttons, drop–down menus and hotwords, hypermedia presentations can be developed. Figure 1 illustrates the use of buttons to select a sequence of displays from a specification's Table of Contents, to the section on packaging, and then to the subsections on palletization and marking, eventually returning to the Table of Contents. Notice the nonlinearity of the route in this hypothetical example.

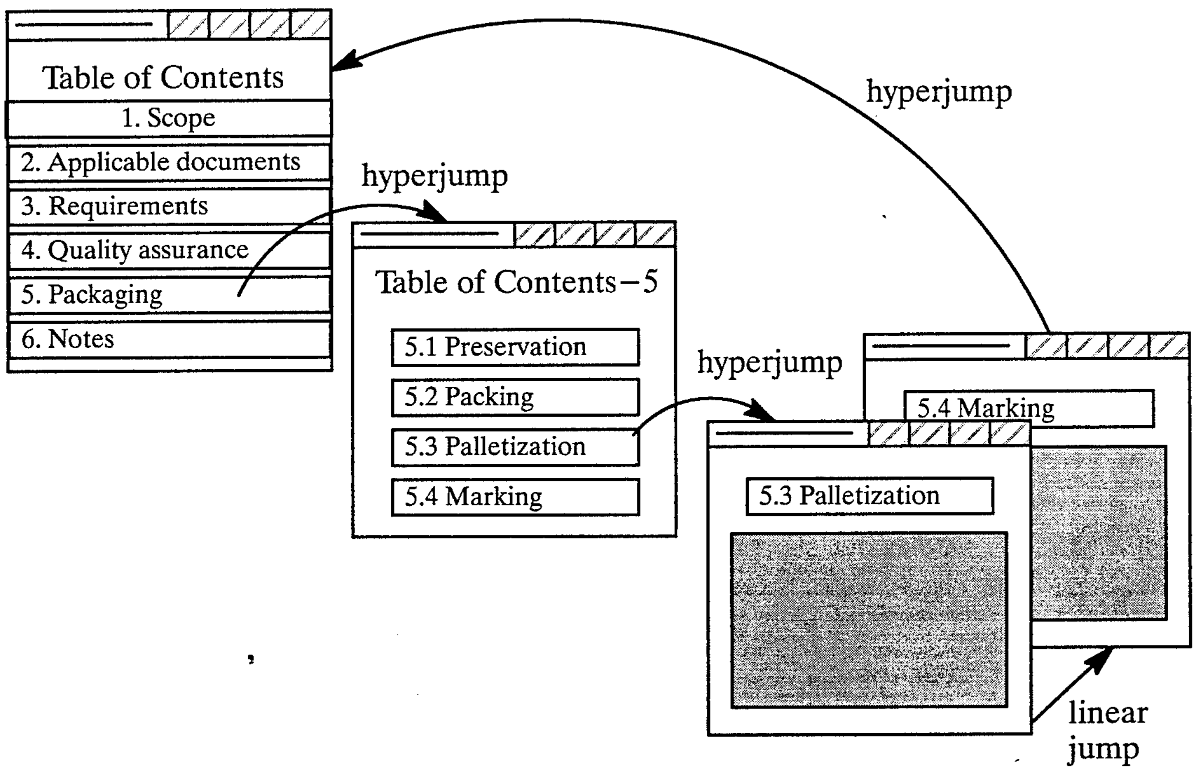

Fig. 1. Hyperdocument navigation

2.4. Organization and user interfaces for hypermedia

An essential element of any presentation is organization and hypermedia is no exception. Our research involved establishing the framework for a library of specifications that detail requirements of various elements of military apparel. Figure 2 reflects the relationships between the specifications that are in the library. For information bearing on the chemical protective suit or the Army men's short sleeve dress shirt one merely clicks a mouse button while the cursor is over the corresponding region of the display window.

In order to add additional specifications to the library, one would simply refine the layout of this "Library" page to reflect the addition. Indeed, if numerous specifications were added, they would be grouped under a common category, such as "Basic Dress Uniform" or "Utility Apparel," and linked to a higher level library page. Thus, the organization would mimic the cataloging systems used in conventional libraries.

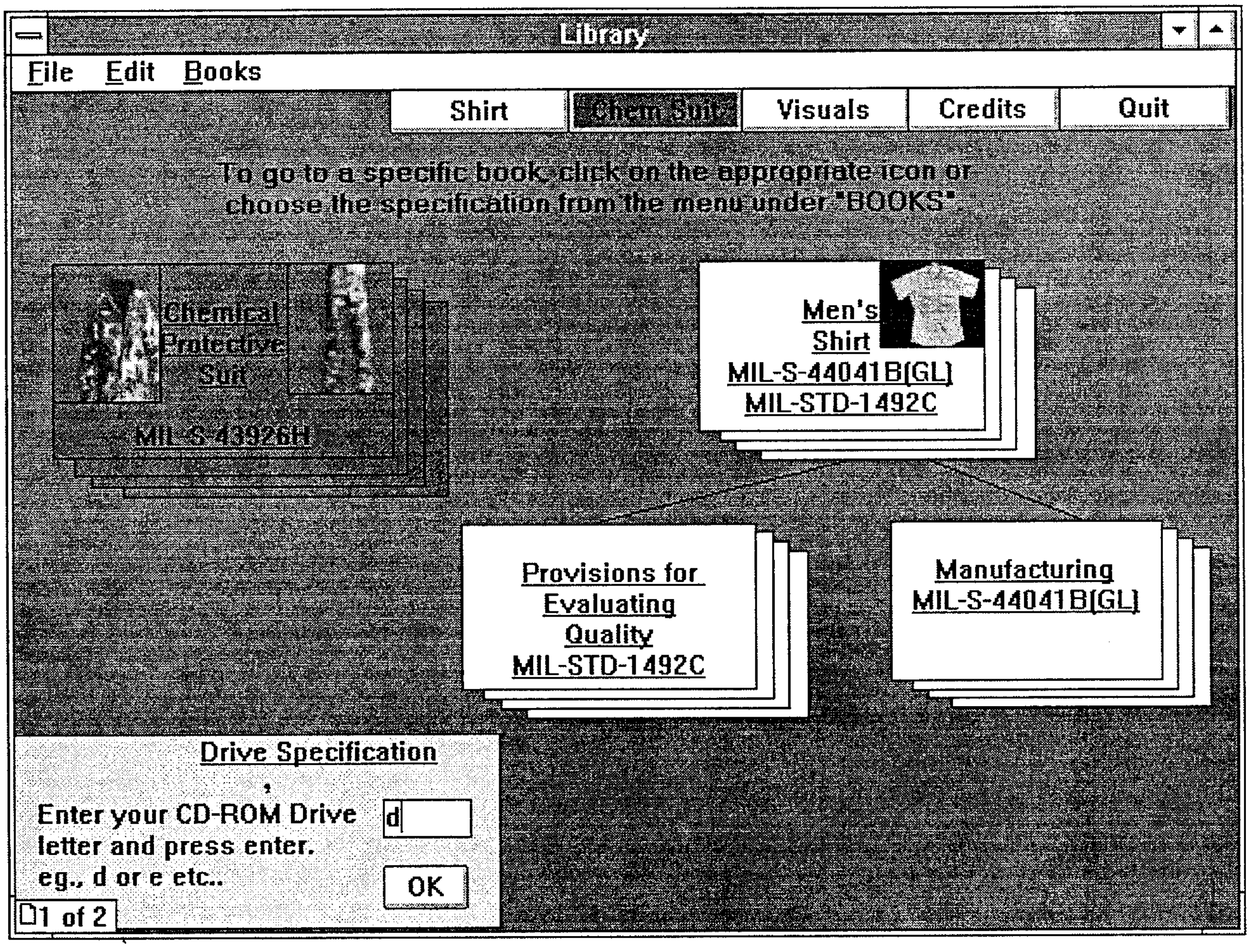

Fig. 2. Current library of specifications

Another aspect of the organization of written documents is reflected in their tables of contents. Through the use of hypermedia, one may also provide all the hierarchical structure reflected by a textual table of contents through a graphical presentation such as the one illustrated in Fig. 3 or through a set of drop-down menus as illustrated in Fig. 4. These menus, such as the one whose caption is "Topics," progressively refine the level of access to the information in a specification. Of course, the hierarchical structure embedded in the menus can be supplied in addition to any other linking or indexing that one chooses to incorporate into a hypermedia presentation of a specification.

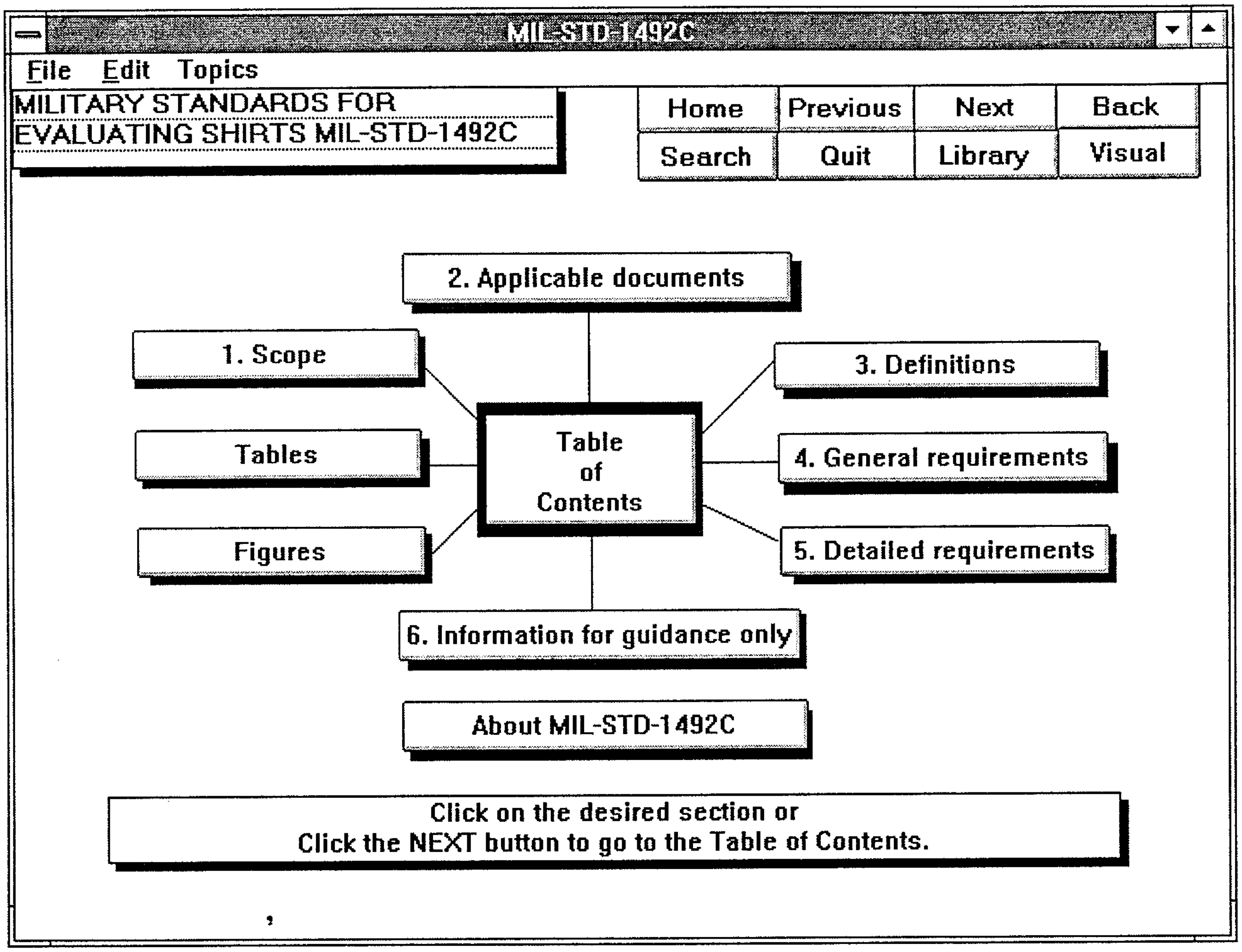

Fig. 3. Specification table of contents

Notice that Fig. 4 actually illustrates several hypermedia, navigational tools. In addition to the "Topics" menu shown in full, there are two other menus: "Detailed Requirements" and "Switching Procedures," each providing access to more detailed information. There are also certain standard buttons such as "Home" that enables one to return to the top level of the specification index and "Library" that would take one to the display in Fig. 2. Finally, observe (in Fig. 4) the hotwords "applicable first value" which link the hypermedia user to additional lot–acceptance information.

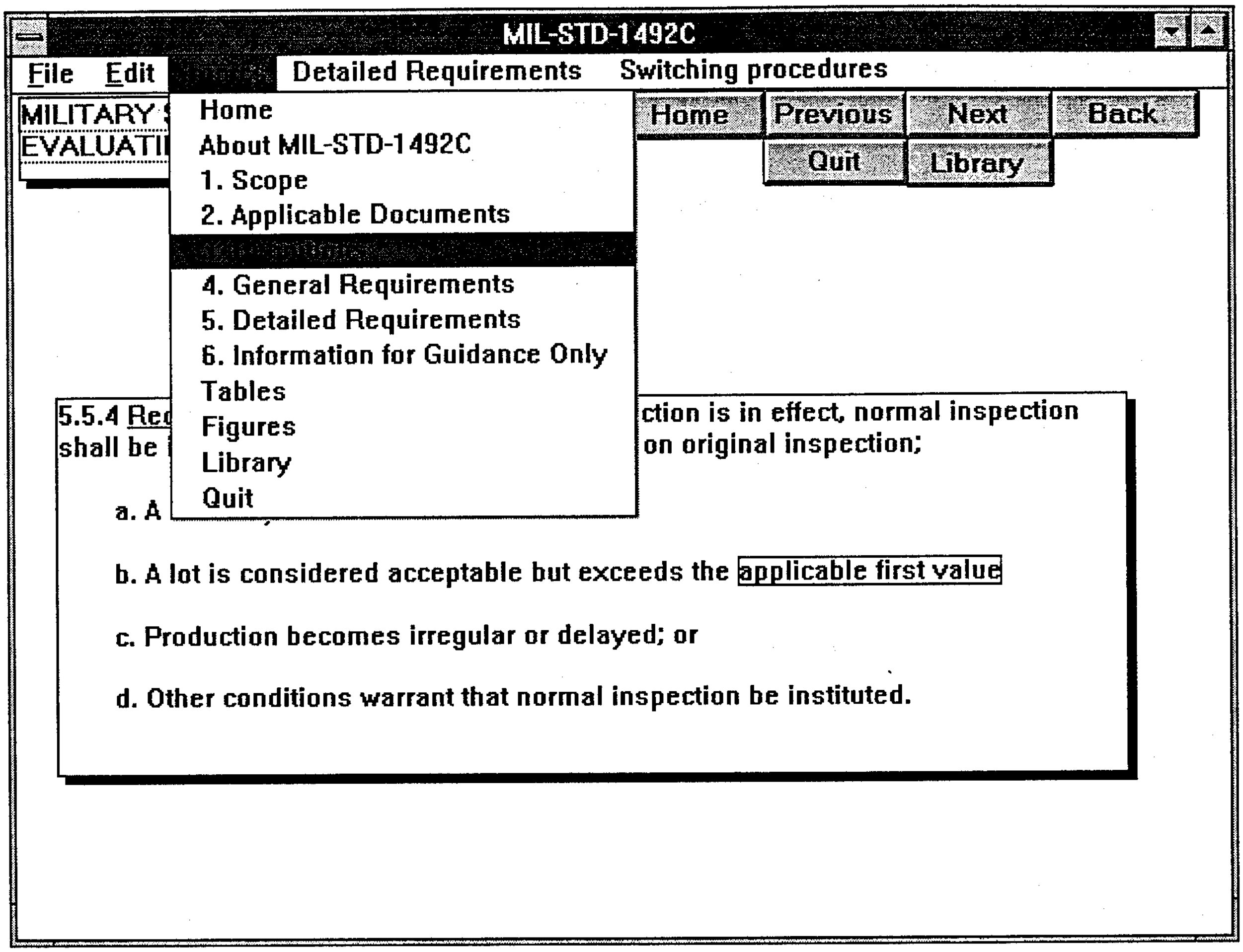

Fig. 4. Buttons, drop–down menus, and hotwords

The organization of a hypermedia document presents several novel opportunities. For example, using hypermedia, one has the capability of augmenting the textual table of contents with a visual table of contents. For the presentations described here, we developed a sequence of images of the Army men's short sleeve dress shirt and the chemical protective suit that allows one who is using the system to select the garment and details of interest by pointing at garment images. These images portray increasing levels of the details for each garment and are illustrated for the men's shirt and the chemical protective suit in Figs. 5 and 6, respectively.

A third element of hypermedia organization is the user interface. A balance must be struck between visual activity and presentation consistency. While users of hypermedia presentations are becoming increasingly comfortable with computers, the navagtional flexibility afforded by hypermedia links can be disorienting. Consequently, hypermedia presentations employ certain techniques to ease the user's burden of maintaining orientation. Among these techniques are: the consistent use of background colors so that each specification has a unique background hue; standard page layouts that implement the general structure of the specification; and provision of a "Home" page and buttons linking each display to the home page. The "Library" page is the "Home" page for the hypermedia presentation that was developed. By rigorously employing these fixed points in the design, the presentation can be perused along any intricate thread of interest and the reviewer will maintain his control over the presentation mechanisms.

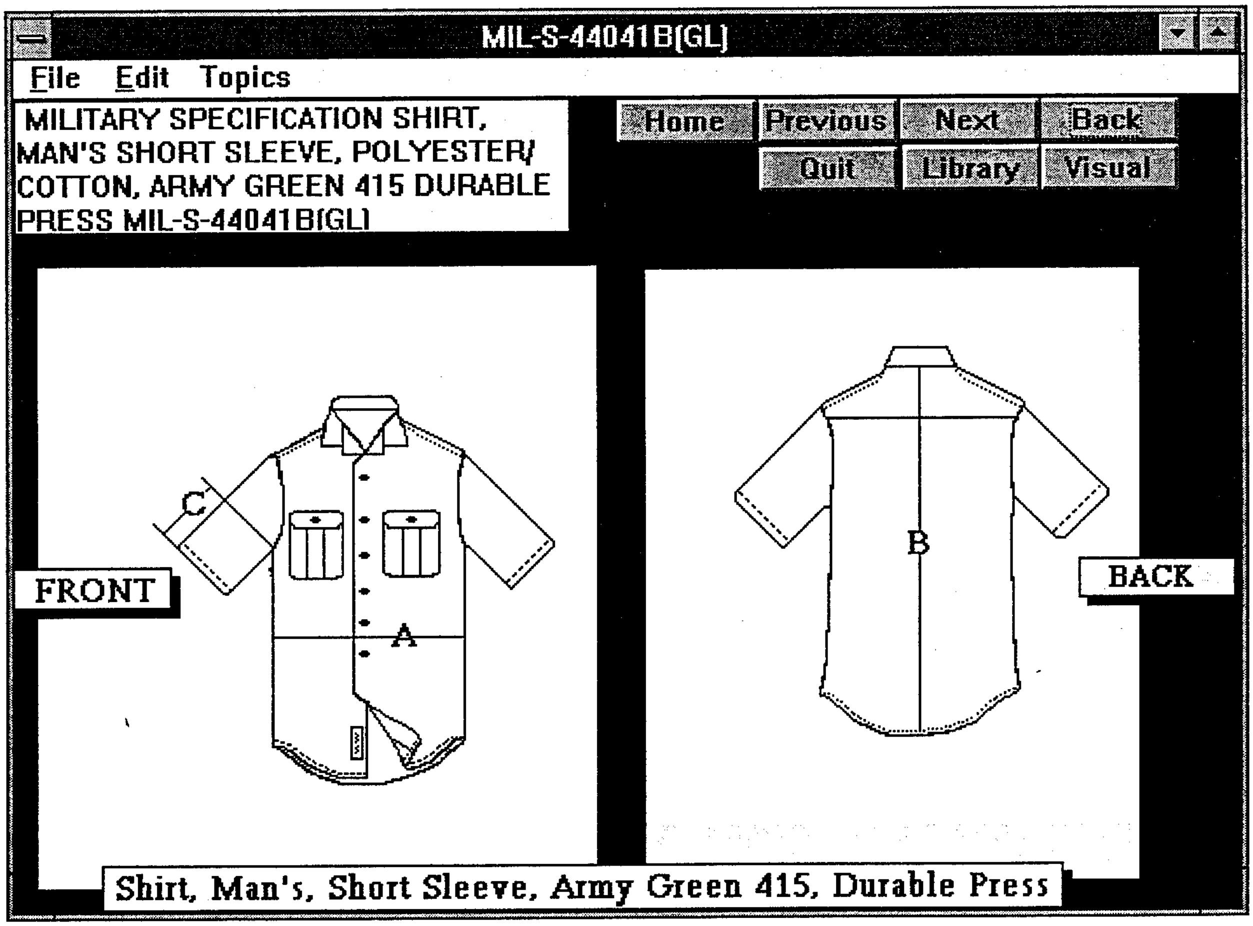

Fig. 5. Visual "Table of Contents"

3.0. Supporting Quality Assurance Activities

One important area of application for the project is in the support of quality assurance activities. An inspector may be called upon to assess a wide variety of products. Since the re-

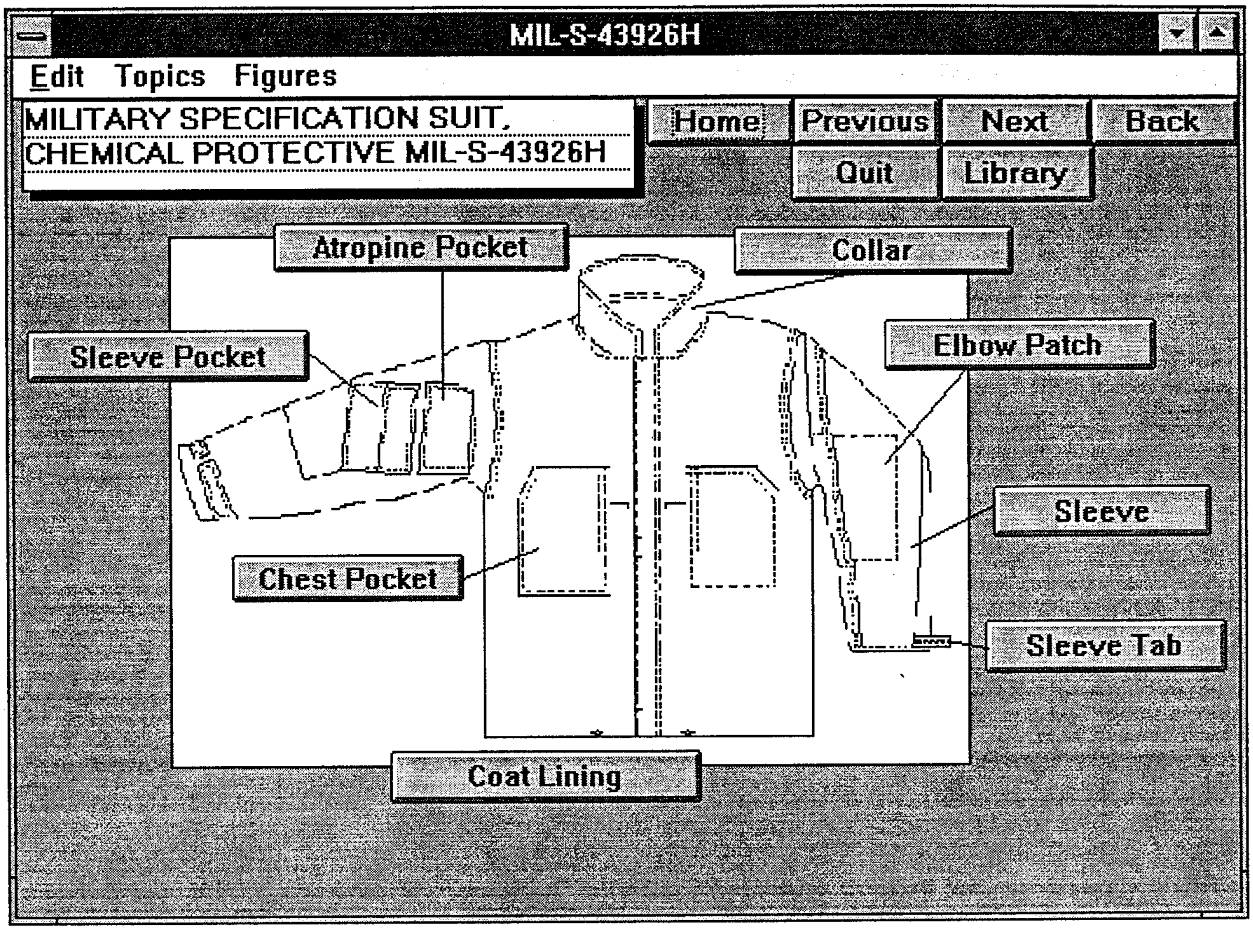

Fig. 6. Visual "Table of Contents" for the chemical protective suit

quirements for those items may, in turn, be involved, hypermedia presentation of the requirements is a natural means of giving an inspector quick access to the information needed for proper evaluation. What is more, evaluation criteria often involve *visually* grading defects that are described within the specifications *verbally*. The ability to present digital images to supplement written specifications is, therefore, a crucial element of hypermedia. Indeed, the hypermedia presentation of the specification MIL–STD–1492C includes over 200 digital images to supplement the text.

While the printed page does not represent the use of color and other cues in the specification, one can readily observe some specimen defects even through printed, halftoned versions of their images. We have included sample pages that represent three defect classes: material, component assembly and alignment defects. Figs. 7–12 illustrate the links between the text of

MIL–STD–1492C and digital images of defect specimens in these three categories, respectively. Digital images of defect specimens were incorporated into the presentation in order to provide additional clarity and to reduce the likelihood of misunderstanding. This increase in the effectiveness of communication should reduce the probability that noncompliant articles will be produced or accepted.

4.0. Developing a Hypermedia Application

4.1. Selecting a Hypermedia Development Environment

The selection of a hypermedia development environment was driven by a variety of objectives. First, since the initial investigations of hypermedia presentation of garment specifications were conducted using a Macintosh computer and resulted in a presentation that executed on that platform, we sought to find a development environment that would allow the existing programs to be converted automatically. In addition, we sought a development environment that could produce a hypermedia presentation that was capable of running without the development software and its associated license or distribution fees. The third objective was to be able to execute the presentation on computers that were controlled by Microsoft Windows®. Also, the development environment had to be capable of producing a presentation that would employ multimedia hardware and data, including bulk storage devices and image data, respectively. Other considerations included the intrinsic functionality of the development environment such as the ability to produce line drawings, the ease of implementing navigation tools such as menus buttons, and hotwords; the accessibility of technicians who could clarify intricately detailed development issues; and the control afforded over individual page displays including such features as the layout, choice of colors or textures, use of overlays to enable multiple themes to be rendered on a single page.

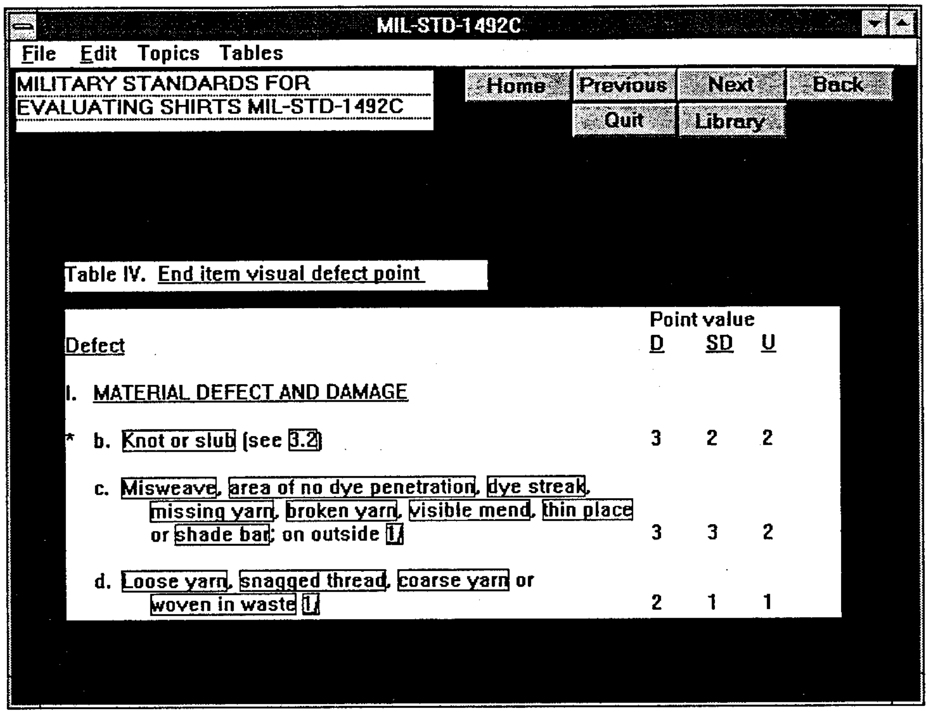

Fig. 7. Point values for material defects and damages

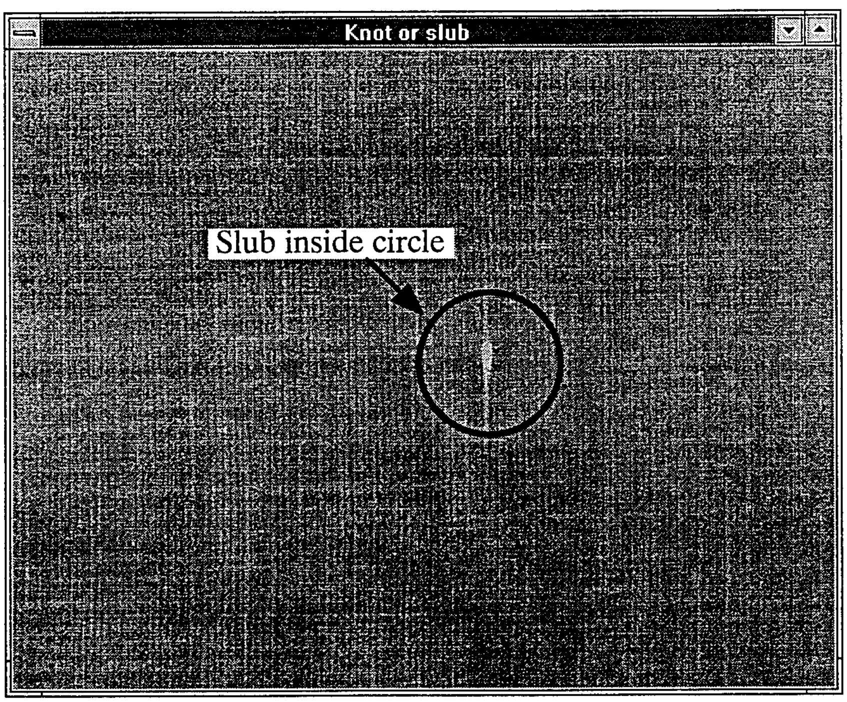

Fig. 8. Specimen of a material defect− −a slub

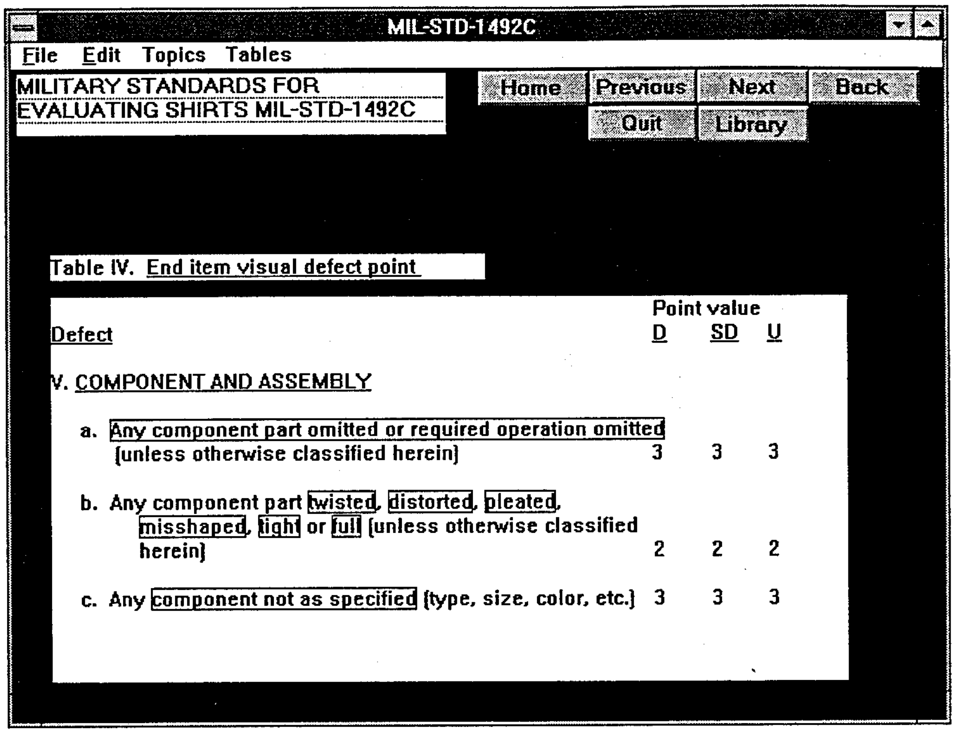

Fig. 9. Point values for component and assembly

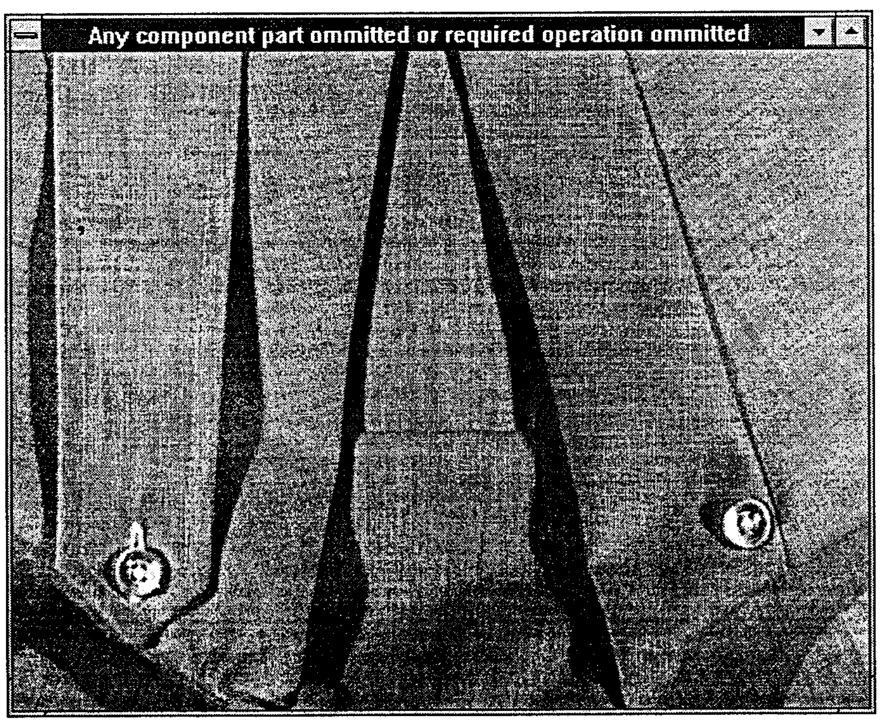

Fig. 10. Missing epaulet

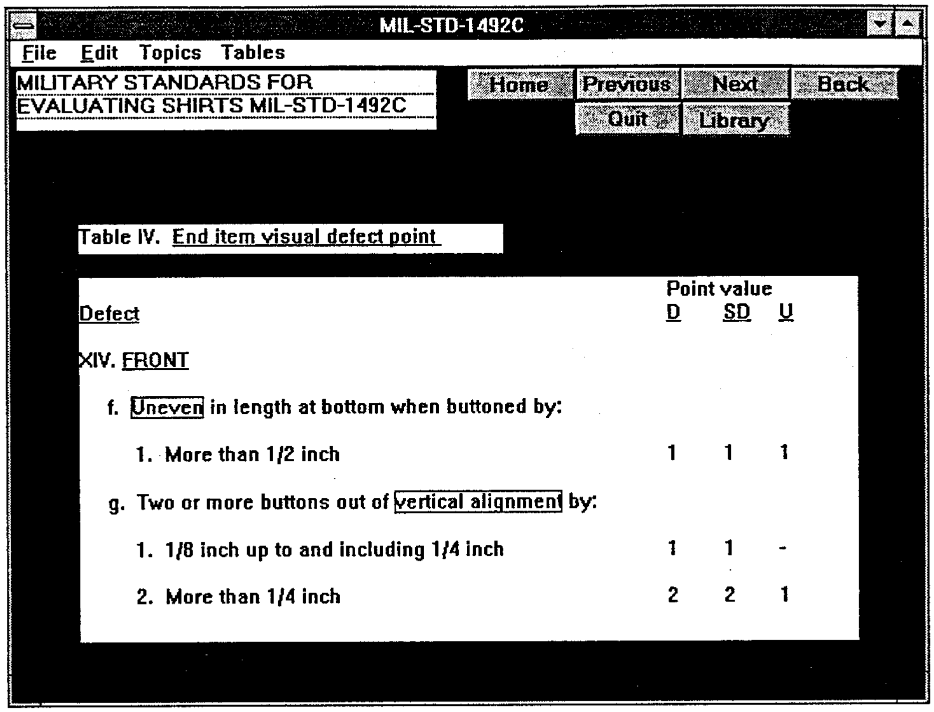

Fig. 11. Point values for defects on shirt front

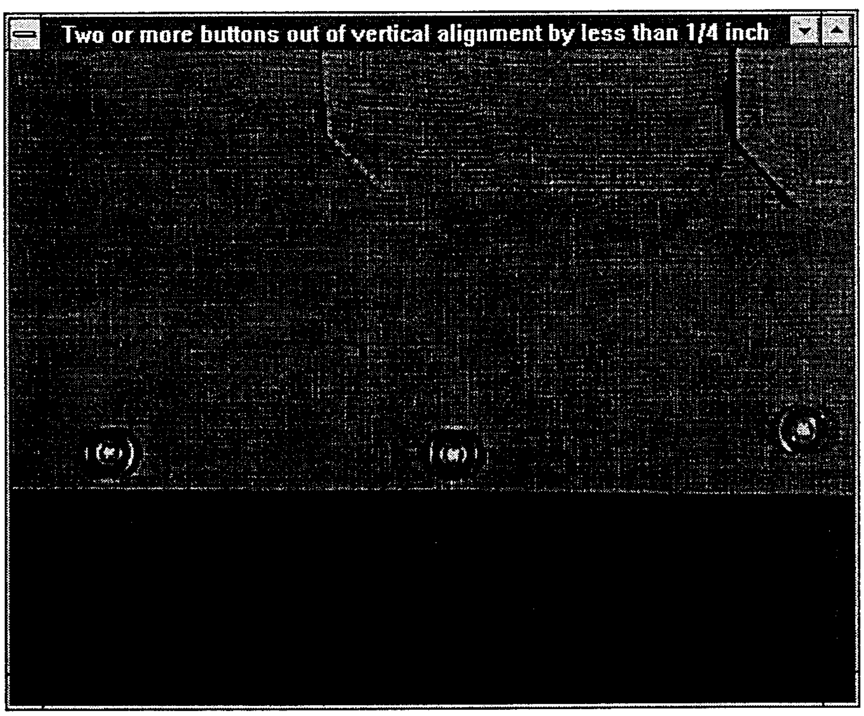

Fig. 12. Mis–aligned buttons

Unfortunately, there was no product that would satisfy the first objective and provide the automatic conversion of the existing Hypercard® implementation of specification MIL–S–44041B(GL). However, after considering 11 candidates, Assymetrix ToolBook® was selected for use as the hypermedia development tool. It is IBM–PC and Microsoft Windows® compatible, gave good control of page design, enabled menu and button implementation, was relatively inexpensive, and could produce a "stand–alone" capable of running independently of the development environment. Furthermore, there were no distribution constraints on the "stand–alone" presentation. Parallel to our evaluation of development environments, we began the process of data collection.

4.2. Data Collection

4.2.1 Producing Defect Specimens

While it is an uncommon objective in typical manufacturing environments, one of the first activities of this project involved producing samples of defective or noncompliant garment features. A technician produced samples of over 200 types and grades defects including examples for each of categories of visually graded defects described in Table IV of MIL–STD–1492C. Some of the defects are readily apparent and easily observable, even to an untrained eye. However, defects such as dye irregularities that are slightly off–color or that possess too broad a variation in saturation are extremely difficult to note visually (or to capture by means of photography). In addition to the digital photographs of the specimens, the original garment defect samples have been preserved for future use.

4.2.2 Capturing Digital Images of the Defect Specimens

Originally we had expected to exploit the services of an educational technology group to acquire the digitized images of defect specimens. However, due to staff reorganization, the role of a video production coordinator in staging, capturing, digitizing and processing images of the shirt defect specimens had to be modified. In order to complete the image acquisition task, we secured access to equipment in the university's Educational Instruction Technology Laboratory (EITL) and learned the basics of the equipment's use. The EITL facility made available its video digitization instruments during times when the laboratory was not scheduled for other purposes.

We captured images with greater color fidelity than standard VGA systems render (16–bit Targa format), and quantized the images so that they could be displayed by standard VGA systems. We used the high fidelity color capture since it was provided by the image capture instruments anyway and because it would be necessary if the project were extended in a future phase to higher level of video display sophistication (such as hypermedia presentation on a computer with high resolution graphics– –SVGA– –capabilities). We discovered that staging the specimens (which includes choosing such things as viewing angle, distance, illumination, field of view and resolution) in order to properly illustrate certain defects was both time consuming and challenging. Nevertheless, high quality images of the sample defects were produced and incorporated into the specifications. However, even with impeccable image data, there is enough variation in the video rendering capabilities of particular installations to warrant linking an image rendering package with the hypermedia presentation.

4.2.3 Preparing the Digitized Images for the Presentation

Even though the images that emerged from digitally photographing the defect specimens represented the irregularities that we sought to display, some additional processing was required. First, an image file format conversion (from the Targa format to the Windows compatible bit–mapped format) was performed so that the hypermedia presentation program could access and display the images. Second, titling, captions, arrows and other attention–directing supplements were superimposed on the images in order to draw the observer's eye toward subtle visual information. For example, Figure 8 exhibits captioning and highlighting that has been used to focus the observer's attention on the slub defect.

4.3. Presentation Organization

4.3.1 Modules

When developing a hypermedia presentation there are a number of creative issues that must be addressed. In addition to deciding what the primary presentation units will contain, one must decide what navigation tools will be used, the layout of each page in the presentation, and the data structures that will be used to provide supporting functions. In order to provide an interface to the project at hand as well as to provide the potential to extend the project to a wider variety of garment specifications, we took an approach that involved creating one, high–level unit to serve as the interface to other, independent modules. This high–level module serves a library type role by presenting the initial link between the user and the specification modules. Each hypermedia presentation of a specification could, therefore, be viewed as an independent module that could be implemented and then linked to the library. As a result, the modules for each specification could be implemented concurrently and, as was necessary for MIL–STD–1492C for example, the implementations could be adapted to the unusual characteristics of the specification. Because of the massive storage requirements of the defect specimen images, the quality assurance module would have been unwieldy had we not segregated the text and linkages from the image files. Indeed, the module not only isolated the images in separate files but it also accesses a file system with multiple sub–directories in order to manage the twenty–six categories of defects associated with Table IV of the specification. By contrast, the storage and data structure manipulations required by the other two specifications are relatively small, even though the presentation of MIL–S–43926H contains over forty line drawings and several images. The line drawings do not require nearly the amount of storage that is demanded by the defect specimen images.

4.3.2 Page Layout

A second creative matter regards the organization and layout of the presentation pages. As illustrated in Fig. 4, a page is analogous to a window and the presentation developer must determine what navigational tools, text, icons, drawings or images may appear and when they will appear. Contrasting the page organization exhibited in Fig. 4 to that in Fig. 3 one may note that some features are similar while others are distinct. The star–like display in Fig. 3 is intended to highlight the role it plays in the hierarchy of the organization––it is an entry point linking the user to the major segments of the specification. Figure 4, on the other hand, has its focus on the textual content of section 5.5.4 of the specification.

The appearance of the drop–down menu in Fig. 4 indicates an alternative mechanism that implements the navigation capabilities conveyed by Fig. 3. The key utility afforded by this menu is to present the ability for the user to return from the lower level of review (section 5.5.4) to the level of the major segments of the specification. The other menus, whose captions appear on the menu bar in Fig. 4, enable the user to gain immediate access to various segments of the specification. Notice that, from left to right, beginning with "Topics," the menu headings represent links to progressively narrower segments of the specification. Indeed, the menus that are available are dynamically presented depending on the depth of detail the reviewer is currently displaying. In particular, because the reader was at the third level of detail (indicated by the display of the section caption 5.5.4), three level of menus are displayed. Thus, at any point in the study of a specification, the reader can navigate to another section of the same or higher level in the organization of the original document.

In addition to the layout of statically placed buttons and dynamically placed menus, a variety of other techniques have been used including invisible buttons and fields as well as overlays. While it is difficult to display invisible buttons, it is easy to describe their use. Primarily, they appear in the visual table contents and activate links to details about various garment components such as collars, epaulets, or buttons. They are also used when multiple text fields are linked to a given page but only one is visible at a time. As the reader advances through the text fields and eventually reaches the last field, a previously visible button (the one that enabled the consecutive display of the text fields) is hidden in order to assure that no attempt is made to read further. Similarly, after advancing from the first of a series of overlay fields, a previously invisible button is revealed that enables one to overlay the previous field instead of the subsequent field. These buttons not only exploit the property of being visible (or invisible) themselves but they also control the visibility of the text fields in order to implement an apparent overlay.

4.4. Image Rendering

As suggested previously, one complication of including digital images in a hypermedia presentation is the variability in the rendering capability of specific computer platforms. The application that was developed during this research is capable of being rendered on a computer with VGA graphics capability including at least 256 colors. Nevertheless, superior image displays will be achieved using machines with greater capabilities. However, as a consequence of user preferences, the specific video monitor display settings employed often vary giving rise to differences in the color quality of the defect specimen images. In order to accommodate this variability and to increase the utility of the presentation as a whole, an image rendering program, known as LView Pro (a copy of the license agreement is in Appendix A), was attached to the hypermedia presentation.

The primary benefit of including the rendering package is the convenience afforded the system user to alter the color balance of an image being viewed. In addition, the package enables substantial control over the color content of an image. By exploring alternative settings, the hypermedia system user can display images that highlight specific features of the defect specimen images that may show critical perspectives that were not necessarily highlighted in the original staging of the image. Thus, the project contains a dynamic potential for rendering perspectives that might have been overlooked during the initial set–up.

5.0. Using a CD to Store the Presentation

5.1. CD Technology Alternatives

Production of a stand–alone hypermedia presentation on a CD involves both the logical processes of collecting, organizing, linking and rendering the information that is to be included and the physical processes of representing that information on the disc itself. While the bulk of our research effort was spent dealing with the logical processes, the effort required to write a CD was also significant. In order to produce a CD, there are couple of alternative strategies that one can pursue depending upon whether the objective is to produce a large or small volume. Service bureaus are agencies with the capacity to receive an electronic or magnetic representation of the data to be placed on a disc and to produce a master that can be used to stamp thousands of CD–ROM discs. After making inquiries of several service bureaus, we determined that the cost of producing a master was on the order of $1,000.00–$2,000.00 per master. In addition, these costs would be incurred even for evaluation discs. Consequently, we considered an alternative technology, known as recordable CD's or CD–R, to store the hypermedia presentation. The CD–R approach yields discs that can be accessed using conventional CD–ROM drives.

The preparatory steps for producing a CD–R are similar to those for a CD–ROM, but the technology is somewhat different. In order to produce a CD–ROM, a metal master disc is manufactured, the master is used to stamp a CD's plastic surface into a particular shape (a process that is analogous to minting a coin), the now irregularly "pitted" surface is coated with a reflective material (typically sputtered aluminum), and the reflective material is coated with a hard lacquer protective layer. The data stored on a CD–ROM is read by monitoring the changes in the intensity of the reflection of a low–power laser beam that scans the pit–track that was stamped into the polycarbonate substrate. The CD–R technology also employs a plastic substrate with a reflective coating; however, the substrate is not pitted by a stamping process. The plastic substrate contains a groove that is treated with a photosensitive dye. By exposing tiny segments of the dye to the light emitted from a relatively strong laser source through a process called "burning," the dye's reflectance properties can be altered and information can be written to the disc. Reading the data stored on a CD–R requires the same type of activity as reading a CD–ROM. Since CD–R discs are relatively inexpensive (on the order of $20.00) for small volume production and a campus research laboratory possessed the capability to write data to the CD–R format, it was selected for use as the database storage medium.

5.2. CD Production

5.2.1 Facilities

Arrangements were made to record a CD (in the CD–R format) containing the complete project using equipment and facilities in the Department of Bioengineering. The first step in producing the CD–R was to migrate the full set of files (data and "stand–alone" hypermedia program interface information) onto the University network; this process, known as "up–loading," required transferring over 200 image files as well as the program files to a specially configured microcomputer that possessed a large disk storage capability and was also connected to the CD–writing machinery. A massive hard disk storage is required because, not only is the source data written to the drive, but also an ISO 9660 image of the entire data set to be written to the CD–R medium must be created and stored prior to writing to the CD–R. The last step involved actual burning the data into the dye used on the CD–R.

5.2.2 Initial Results

Our initial production efforts provided a CD that appeared to contain the files that were written but those files proved to be inaccessible. The problem arose as a consequence of file system features that differ from those of an IBM–PC compatible. Recall that the point of origin of the hypermedia presentation was an IBM–PC compatible platform running under Windows, the vehicle of transfer was a network that was running under the Unix operating system, and the destination machine that hosted the CD–writing drive was a Macintosh. Specifically, the problem arose because IBM–PC Windows compatible file systems do not distinguish between upper– and lowercase letters in file names whereas Unix systems do. Once we corrected this problem, our second CD proved partially amenable to being read; some files were accessible while others were not. The problem this time arose because of a restriction in the ISO 9660 standards for CD–ROM's that prohibits the use of the hyphen "–" as a part of a file name (the ISO 9660 requirement allows uppercase letters, the digits "0" through "9" and the underscore character "_" to appear in file names). Accommodating this constraint took a significant amount of time because the resolution of the problem not only required renaming all the files (primarily those containing defect specimen image data) whose names incorporated a hyphen, but it also necessitated editing each programming script associated with an image data file that was renamed in order to reflect the change in the file name. The third writing effort produced a useable CD–R recording of the hypermedia presentation.

Having the hypermedia presentation in the CD format provided us with new capabilities. First, the format allowed us to observe the performance using the CD medium. There had been initial concerns that the time to transfer image data files from the CD to video memory for display might be excessive. An alternative that was considered was compressing the image data so that the data transfer time would be minimized and then decompressing the data whenever an image was to be rendered. Interestingly, the decompression time combined with the time to link to the decompression algorithm and then return its results to the rendering utility virtually matched the time required to transfer an uncompressed image file. Consequently, the image files were allowed to remain in an uncompressed form. However, if one sought to store a larger library of images or a wider variety of specifications on a single CD, it would be prudent to allow the image data files to be compressed.

A second benefit to accrue to having the CD format is that it consolidated the hypermedia presentation of the specifications on a single nonvolatile medium. Previously, the presentation programs and their data existed in files on a hard disk backed–up by scores of floppy disks– –both types of storage are vulnerable to unexpected magnetic or mechanical breakdown. However, the CD–R format is not subject to the hazards of stray magnetic fields or disk head "crashes." In addition, the CD–R recording can be used as a source of data for producing a master die in the event that large–volume production should be desired.

5.2.3 Perspective and Application

In order to appreciate the information content of the project, one may note that it occupies approximately 100 MBytes of storage. While this is the equivalent of 100,000 pages of printed text, the majority of the storage volume is occupied with data for the images of defect specimens that supplement MIL–STD–1492C and line drawings of the patterns that supplement MIL–S–43926H. While the project requires a large amount of storage, it occupies substantially less data space than a typical CD–R disc can hold; indeed, the project requires approximately 20% of the capacity of a typical CD–R disc. Instructions for using the presentation are contained in Appendix B.

6.0. Future work

The fact that a significant fraction of a typical CD would be available for use enables us to consider two parallel paths for future development: incorporating images with higher resolution and adding specifications for other articles of apparel. The first area is important because the quality of video monitors and display systems is dramatically improving and employing higher resolution images would increase our ability to illustrate defects such as those related to fabric fading, shading or staining. The importance of the second area lies in the fact that with more specifications in hypermedia form on a single CD–ROM, the range of potential users is broader. Another extension to this research would be to incorporate voice control of the hypermedia navigation structures by complementing mouse selection of menu items and hotword links with a spoken language interface.

7.0. References

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4. Schneiderman, Ben and Greg Kearsley, *Hypertext Hands–On!: An Introduction to a New Way of Organizing and Accessing Information*, Addison–Wesley Publishing Company, Reading, Massachusetts, 1989.

5. U.S. Department of Defense, "Military Specification: Shirt, Man's, Short Sleeve, Army Green 415, Durable Press," MIL–S–44041B(GL), 30 June 1988.

6. U.S. Department of Defense, "Military Standard Provisions for Evaluating Quality of Men's Shirts," MIL–STD–1492C, 10 June 1988.

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Appendix A

LView Pro

Non-exclusive Distribution

License Agreement

LView Pro

LView Pro Non-exclusive Distribution License Agreement

This agreement (**Agreement**) is made between Leonardo Haddad Loureiro, author of LView Pro, an image editor software for the Microsoft Windows environment, and Gene A. Tagliarini, Ph.D., Research Associate and Assistant Professor of the Department of Computer Science. College Sciences. Clemson University.

WHEREAS, Gene Tagliarini, on behalf of Clemson University, desires to obtain from Leonardo Haddad Loureiro the right to distribute the SHAREWARE version of LView Pro (**LView Pro**), targeted to the i386 processor, built as a 16-bit application for the Microsoft Windows 3.1 operating system;

WHEREAS, Leonardo Haddad Loureiro is willing to grant limited and free of charge distribution rights to the above specified version of LView Pro;

Non-exclusive distribution terms

1. Clemson University may distribute up to a maximum of 20 copies of LView Pro, packaged with the CD-R containing the ToolBook prototype

2. Neither Gene Tagliarini nor Clemson University may acquire profit from the above specified LView Pro distribution

3. Clemson University may charge appropriate fees from users, to cover for distribution costs

4. LView Pro's package must be integrally distributed, with all its associated help and readme files

5. This Agreement is non-exclusive, non-transferable, and restricted to the terms specified herein

Leonardo Haddad Loureiro, 9/19/1994

Appendix B

Usage Instructions

System Requirements

In order to use the hypermedia presentation of garment specifications that was written on the compact disc (CD) that was developed during this research, one must have a computer system capable of running Windows 3.1® and rendering images in at least 256 colors. In addition, at least 4 Mbytes of RAM and an Intel 386 (or higher) central processing unit are recommended. A correctly installed and functioning CD–ROM player is also required.

In order to make certain files readily accessible, the installation procedure loads them onto the hard disk. Consequently, complete installation requires approximately 10 Mbytes of storage space on the system hard disk.

Installation

The following script should be followed for installing the CD containing the hypermedia presentation developed under this project. These instructions assume that a stand–alone hypermedia presentation is to be made and that the system user is not already using the Toolbook application.

```
Instructions
-------------

1. Create a directory "Toolbook" from "C:"
        c:\>md toolbook
2. Go to toolbook directory on the hard drive.
        c:/> cd toolbook
3. Go to CD-ROM drive /toolbook. eg. d:/toolbook,
   and type setupfin c:
        c:/toolbook> d: (assuming d is the CD drive)
        d:> cd toolbook
```

d:> setupfin c:

When asked "Do you want .....?" type "y"

4. Go to c:\toolbook
5. Type gzip103 from c:\toolbook
6. Type gzip –d *.tbz from c:\toolbook
7. Now go to "C:\toolutil"
8. Copy all files from d:\toolbook\toolutil

   c:\toolutil>cp d:\toolbook\toolutil*.*
9. From the File Manager Associate "library.tbk" in "c:\toolbook"

   with "C:\toolbook\runtime\tbook.exe"
10. Edit "win.ini" file from "C:\windows" and add the following

   2 lines at the end of the file :

   [Toolbook]

   startupSysBooks = C:\toolbook\tbkmm.sbk
11. Restart your computer for the effects to take place.
12. Click on library.tbk to start the application.

Basic Usage

When the application is started by double–clicking on the "LIBRARY.TBK" file, an Asymetrix Corporation copyright notice appears briefly and then is replaced by the hypermedia garment specification display shown in Fig. 1 (and duplicated from Fig. 2 in the text and used here for convenience of reference). This display is called the "Home Page" of the database and serves as a known starting point for perusal. In addition, every other display is linked to this page so that at any time desired, the user may return to this page. Review of a specification can be initiated by placing the mouse pointer over one of the regions that is illustrated by a stack of index cards and labeled with the nomenclature of the specification and then "double clicking" the left mouse button. From this point on, the page that is displayed will depend upon the specific route that is taken and, consequently, will have properties and navigation options that depend upon the path.

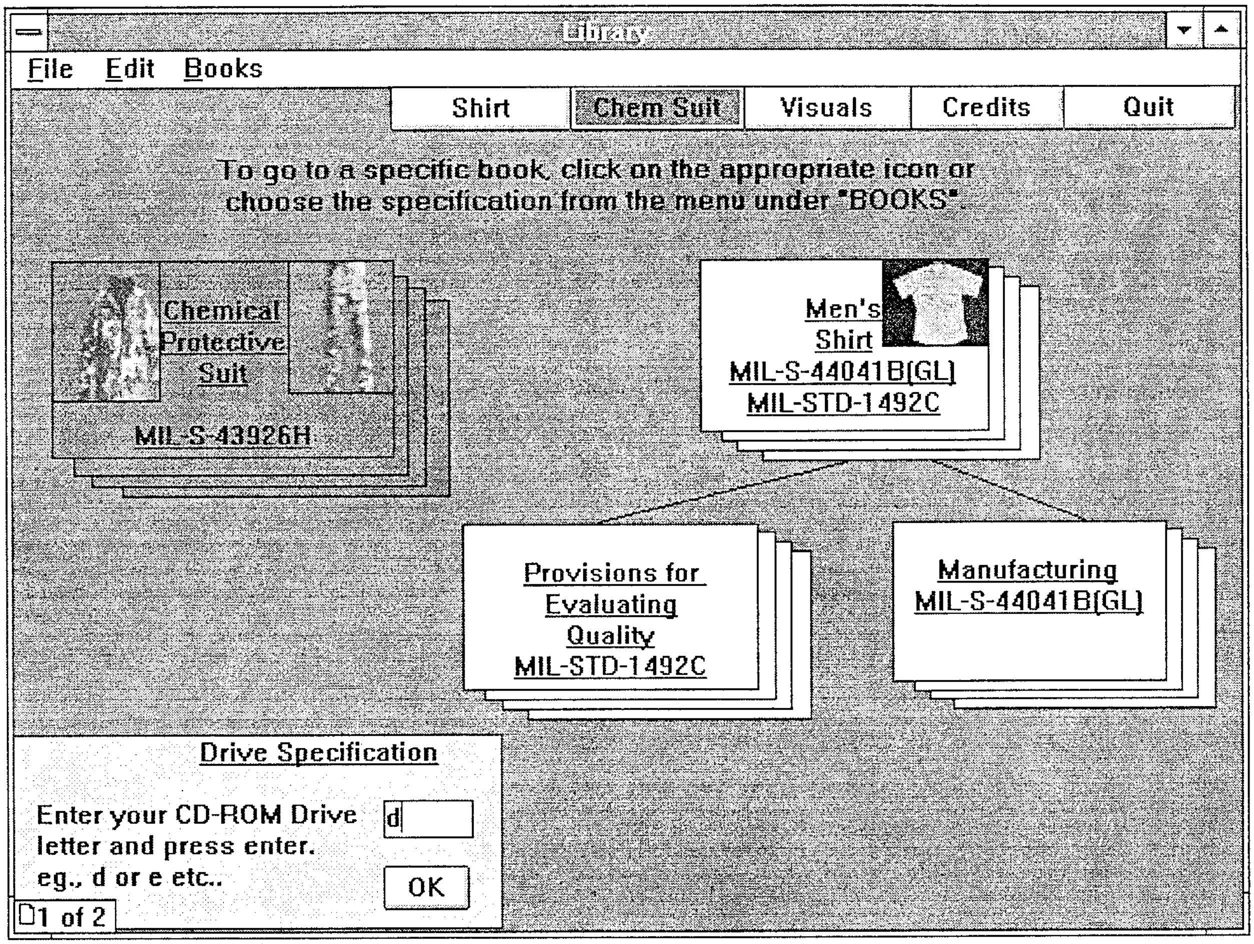

Fig. 1. Project Home Page

One possible choice would have been to have selected MIL–STD–1492C and to have begun a review of quality assurance standards. Had this path been selected, the next display that the user would observe would be the one shown in Fig. 2 (and duplicated from Fig. 3 in the text and used here for convenience of reference). This page reveals navigational choices that reflect both the structure of the specification and that of the hypermedia presentation. The set of buttons that is organized like the numbers on the face of an analog clock, for example, represents the first level of the organizational hierarchy of the specification. The eight buttons in the upper right-hand corner but just below the menu bar represent navigation options that are commonly available throughout the presentation. The menu bar displays the captions for drop–down menus that offer presentation management and navigation options.

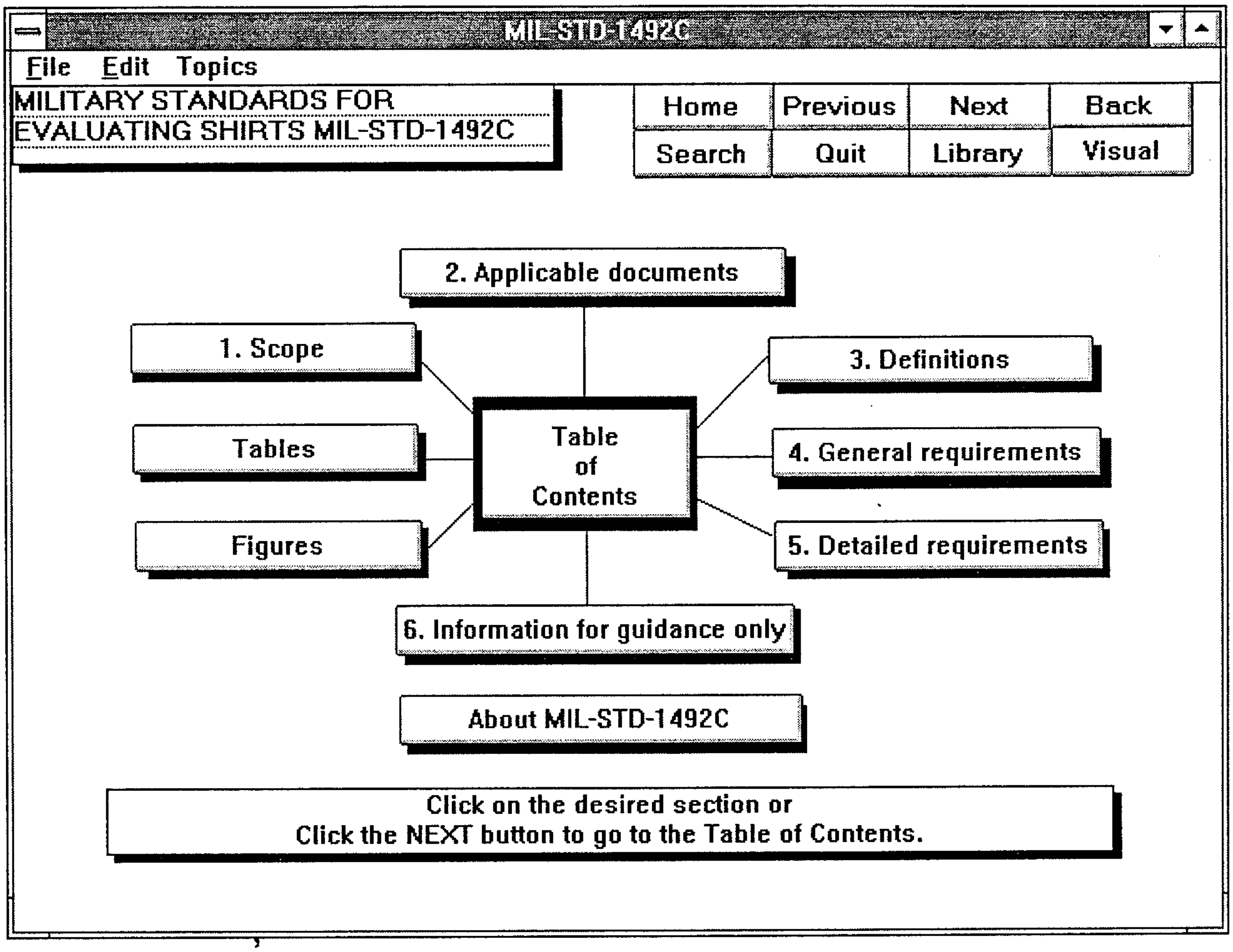

Fig. 2. MIL–STD–1492C Home Page

The functions of the common buttons that are in the cluster of eight are as follows:

Home: Return the user to the project home page;

Previous: Display the preceding page in the specification;

Next: Display the subsequent page in the specification;

Back: Display the page that was visible immediately prior to the current one;

Search: Enable a search screen that will allow the user to search the specification for occurrences of key words or phrases;

Quit: Stop the presentation and close all open presentation windows;

Library: Return to the Library page; and

Visual: Display the Visual Table of Contents for the Specification.

The remaining buttons will display the initial page of the section selected.

The page illustrated in Fig. 3 exhibits an additional navigational feature and a useful type of text field. The navigational feature illustrated is the "hotword." In this figure, the framed section numbers are links that are activated by clicking the mouse button while the pointer is over the hotword, such as **4.4.1.1**. For example, clicking on **4.4.1.1** would immediately display the page with section 4.4.1.1 on it.

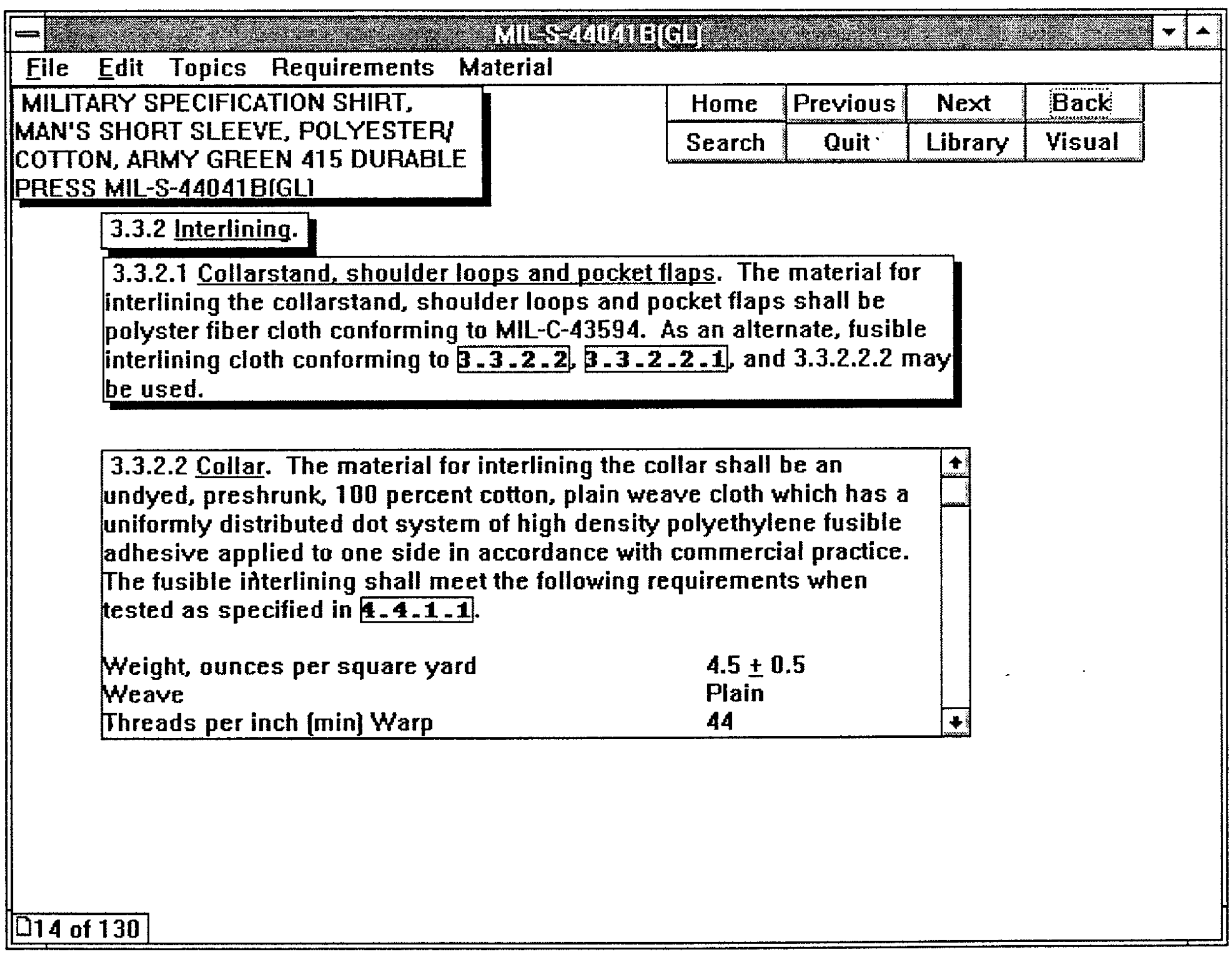

Fig. 3. MIL–S–44041 Sample Page

The other new feature illustrated on this page is the scrolling text field. When there is more text than can conveniently be placed on a page, scrolling fields are employed. More text than is initially displayed can be revealed by placing the mouse pointer over the scroll bar at the right of the field and then holding the left mouse key down. The hidden text will scroll into the display area of the scrolling field.

The sample page displayed in Fig. 4 shows two other useful features. First, notice the long button that is labeled "View/Enhance Last Image." This button only appears in pages associated with Table IV of MIL–STD–1492C and is the mechanism by which to return to the display of a defect specimen image and the rendering utility.

The other feature illustrated here is on the menu bar. Notice that several menu captions have appeared. Menu captions appear and provide links to all major sections and subsections at the same level or higher than the currently displayed page. The captions are dynamically replaced depending upon the level and section that is currently being studied.

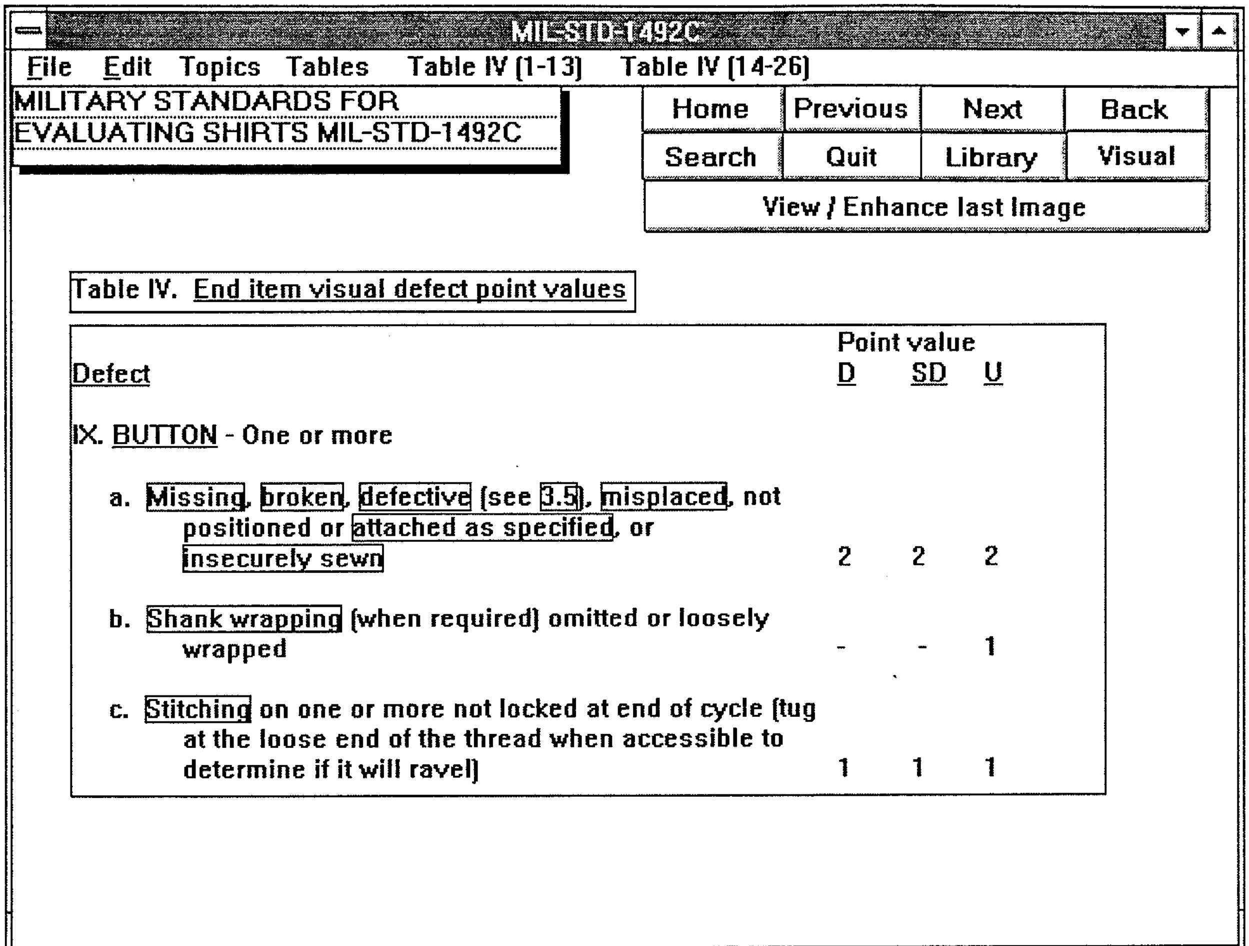

Table IV. End item visual defect point values

Defect	Point value D	SD	U
IX. BUTTON - One or more			
a. Missing, broken, defective (see 3.5), misplaced, not positioned or attached as specified, or insecurely sewn	2	2	2
b. Shank wrapping (when required) omitted or loosely wrapped	-	-	1
c. Stitching on one or more not locked at end of cycle (tug at the loose end of the thread when accessible to determine if it will ravel)	1	1	1

Fig. 4. Hypermedia Connection to Image Rendering Program